

THE
JOURNAL OF ECONOMIC BIOLOGY

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THE
JOURNAL OF ECONOMIC BIOLOGY.

ON SOME COCCID PESTS OF ECONOMIC IMPORTANCE.

By
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Entomologist to the Government of Ceylon.

WITH PLATES I AND II.

THE insects described below have been received from several sources and countries, but—being all of some economic importance, can be conveniently discussed together.

***Aspidiotus oceanica* (Lindinger).**

Pl. i, figs. 1-9.

Furcaspis oceanica, Lindinger; Zeitschr. wiss. Insektenbiol., 1909, Bd. v, p. 149.

Female puparium (Pl. i, figs. 2, 3) irregularly subcircular to oval, usually tapering behind: slightly convex above. Pellicles concealed, but their position (towards anterior extremity) marked by a central nipple-shaped boss and concentric circles. Colour dull to bright castaneous: the area covering the pellicles often paler, with the exception of the extreme centre, which is usually darker with a central white spot. Undersurface (Pl. i, fig. 3), with a median cavity covered by the dense whitish ventral scale, which is confined to the central area, exposing a broad marginal zone of the dorsal scale; some more or less conspicuous, curved, branching, whitish ridges radiating from below the edges of the ventral scale towards the margin. Length, 2.5 to 3 mm. Breadth across the widest area, 1.75 to 2 mm.

Male puparium (Pl. i, figs. 4, 5) irregularly oval, usually narrower behind; resembling that of the female, but smaller and proportionately narrower. Undersurface (Pl. i, fig. 5), with a median channel partly covered by the ventral scale which forms a narrow zone bordering the channel; median area whitish. Length, 1.5 mm. Breadth, 0.75 mm.

Adult female (Pl. i, fig. 6) blackish (in alcoholic examples), probably purplish in life. Body subcircular, the pygidium forming a projection behind. After oviposition, the ventral segments contract and the pygidium is more or less withdrawn into the ventral area. Marginal area of body, with scattered longish whip-like hairs (Pl. i, fig. 9). Antennae rudimentary, with four or five stout bristles (Pl. i, fig. 9 a). There is a submarginal scattered group of minute conical papillae (Pl. i, fig. 9 b) on the undersurface, on each side, between the antenna and the anterior spiracle (Pl. i, fig. 9 c). Anterior spiracles with, posterior spiracles without, parastigmatic pores. Pygidium (Pl. i, fig. 7), with the lateral margins strongly and densely cristate and serrulate. Six terminal lobes; their extremities rounded and entire; the outermost slightly the broadest, with straight sides; the median pair slightly narrowest, both this and the second pair slightly constricted at the base. Squamae broad, their extremities (in fresh examples) tridentate (Pl. i, fig. 8), but often so imperfect that their form is difficult to determine. Paraphyses slender, eight to ten on each side, often obscure and inconspicuous. Anal aperture moderately large and conspicuous, placed about midway between base and apex, partly encircled by a chitinous thickening. No circumgenital pores. Dorsal pores few, small and inconspicuous, subcircular to oval. There are from one to three long stout whip-like hairs on each side at the base of the pygidium. Marginal spines small and inconspicuous. Derm of pygidium minutely longitudinally wrinkled. Length of extended insect, 1 to 1.25 mm. Breadth, 0.75 to 1 mm.

Adult male unknown.

Habitat.—On fronds of the Coconut Palm (*Cocos nucifera*): Yap, Caroline Islands. The insects are crowded upon the upper surface of the fronds and scattered more sparingly on the under-surface, on each side of the midrib.

The insect closely resembles, and is indeed very nearly allied to *Aspidiotus cladii* of Maskell—a species that appears to be confined to plants of the order *Cyperaceae*. It may be distinguished from *cladii* by the usually more elongate puparium of the female: by the greater size of the adult insect; by the form of the pygidial lobes which—in that species—are relatively narrower and are more or less emarginate: by the second lobe being single instead of duplex (as in *cladii*): by the greater density and extent of the lateral cristate area: and by the well defined anal aperture (which is obscure and difficult to locate, in *cladii*).

A. oceanica also bears a superficial resemblance to *Chrys-*

omphalus propius of Banks, which occurs on Coconut Palms in the Philippine Islands, but that species is amply distinguished by the presence of circumgenital pores and by a stout chitinous spine on each side of the thorax.

The specimens were submitted with a note to the effect that "the Coconut estates of the South Sea Islands are suffering enormously from the ravages of an insect which endangers (according to scientists) all the coconut plantations of the Caroline Island Yap."

I have no particulars as to whether the pest is attacking the mature trees or whether it principally affects the younger plants. If the latter is the case, it should be possible to check the attack by the application of one of the recognized washes: but it would be extremely difficult to spray effectively the crowns of full-grown palms.

Asterolecanium pustulans, Ckll., var *seychellarum*, nov.

Pl. i, figs. 10-12, Pl. ii, figs. 13, 14.

Asterolecanium fustulans, Ckll.: Journ. Inst. Jam., 1892, 1, p. 143.

Test of adult female (fig. 2) broadly ovoid, sometimes approximately circular: terminating in a slightly prominent point behind: moderately convex: posterior half with more or less distinct median and lateral carinae: transversely rugose. Fringe moderately long: rather loose: usually interrupted at irregular intervals: the second (nymphal) series broken up into more or less distinct bundles: third (larval) series usually obsolescent. In very fresh (younger) examples, there are traces of curling discal filaments: but, in older examples, the disc is usually bare. Colour greenish yellow: the dried body of the insect showing as a brown anterior patch through the transparent scale: fringe slightly tinged with pink or orange. Average length, 1.25 mm. Breadth, 1 to 1.12 mm.

Male puparium undetermined. A smaller, flatter scale, with more distinctly orange fringe, and proportionately more oblong, may be either the male puparium or the test of the nymphal female.

Adult female insect (Pl. i, figs. 11 and 12) broadly oval. Antenna consisting of a densely chitinous circular plate bearing three or four stout curved bristles. Rostrum slightly in advance of a median transverse line. Abdominal extremity (Pl. ii, fig. 13) with short broad anal lobes, each bearing a longish stout seta: a pair of inner lobes, rather more densely chitinous than and as large as the outer (anal) lobes, each bearing one stout spine and several smaller spines. Anal ring with six stout hairs, not reaching the margin. Chitinous lip of anal aperture broadly transverse. Area of anal pit

demarked by slight chitinous thickenings of the derm. A single marginal series of paired pores (Pl. ii, fig. 14); closely set, and continuous almost to the anal lobes. Ventro-marginal simple circular pores large and well defined: with a scattered inner series of similar but smaller pores. Disc of dorsum irregularly strewn with paired pores distinctly larger than those of the marginal series, with a slight tendency to arrangement in longitudinal and transverse series on the abdominal area. Length, 0.65 to 0.85 mm. Breadth, 0.5 to 0.75 mm.

Adult male unknown.

Habitat.—On stems and branches of *Hevea brasiliensis*, Seychelle Islands. Submitted by Mr. R. Dupont, Superintendent of Botanic Stations.

The insects occupy small depressions on warty swellings of the bark (Pl. i, fig. 10). When they occur in considerable numbers, the bark assumes an unhealthy hidebound and nodular condition that must greatly interfere with the processes of tapping, and may even check the elaboration of latex.

Typical *pustulans* is recorded only from the tropical and sub-tropical regions of the Western Hemisphere. The variety under consideration differs from the type merely in superficial characters of the secretory covering. In typical *pustulans* the test is opaque; not markedly rugose, but distinctly granular, with numerous curling glassy filaments on the disc.

In the Seychelles, the pest is kept in some check by a parasitic fungus. The earlier specimens that were submitted to me were so thoroughly infected that—out of many hundreds of individuals—I was unable to find a single insect in a fit condition for description.

The habit of pitting the bark of the plants upon which they subsist is common to the four species *variolosum*, *pustulans* (and its variety), *ventruosum* and *thespesiae*. They may be separated by the following characters:—

- I. ♀ Puparium *flat* or *concave* above. Marginal series of paired pores double.
No discal paired pores *ventruosum*, Mask.
- II. ♀ Puparium markedly *convex* above.
 - A. Marginal series of paired pores *double*. Discal paired pores present; of same size as marginal pores *thespesiae*, Green.

B. Marginal series of paired pores
single.

1. No discal paired pores ... *variolosum*, Ratz.
2. Discal paired pores present:
larger than marginal pores.
 - a. Puparium opaque: disc with
curling glassy filaments:
distinctly granular: not
markedly rugose ... *pustulans*, Ckll.
 - b. Puparium transparent: discal
filaments obsolete: rugose:
not markedly granular ... *seychellarum*, Green.

***Eriococcus paradoxus*, Maskell.**

Eriococcus paradoxus, Mask.: Tr. Roy. Soc. S.Austr., 1888, p. 104.

Eriococcus paradoxus var. *indicus*, Mask.: N.Z.Trans., 1897, xxix, p. 318.

Eriococcus paradoxus var. *simplex*, Mask.: N.Z.Trans., 1897, xxix, p. 244.

Mr. E. P. Stebbing, Zoologist to the Imperial Forest School, Dehra Dun, has submitted to me examples of the Coccid referred by Maskell to his *Eriococcus paradoxus*, under the varietal name of *indicus*. An examination of this material shows me that the species is distinct from *E. paradoxus*, and that both of these insects are wrongly included in the genus *Eriococcus*. They are typical examples of the genus *Cerococcus* of Comstock.

Eriococcus paradoxus, Mask., should therefore be called *Cerococcus paradoxus* (Mask.), and *Eriococcus paradoxus indicus* (Mask.), will become *Cerococcus indicus*, Green.

Of *Eriococcus paradoxus simplex*, I am unable to speak with certainty, as I have not seen the insect. Maskell's description states that it differs from the type in the absence of paired glands. A study of the early stages of the insect would be necessary to decide whether it, also, can be included in the genus *Cerococcus* or even whether it is an *Asterolecaniid*.

I append a diagnosis of the new species.

***Cerococcus indicus*, n.sp.**

Pl. ii, figs. 15-22.

Test of adult female subcircular: strongly convex: covered with a coarse filamentous tomentum which—in early adult individuals—it of a rusty orange colour, but—in old examples—is dull reddish brown. The insects are so crowded together (Pl. ii, fig. 15) that the form of the individual test is obscured; but there are indications which suggest that—in an isolated individual, with free

room for development—there might be some segmentation of the tomentum into more or less definite tufts. Diameter of fully developed test approximately 2.5 mm.

Male puparium oblong oval: moderately convex: hinder third depressed and covered by a circular operculum. Fresh examples sparsely covered with rust-coloured filaments: older examples often naked. Length, 1.25 mm. Breadth, 0.75 mm.

Adult female (Pl. ii, fig. 16), broadly oval: abruptly constricted and tapering behind. Posterior extremity (Pl. ii, fig. 17) with the usual conical fleshy lobes, each supporting a longish stout seta at its apex and two or more stout curved blunt spines on its inner margin. In older examples the setae are often turned back and lie along the margin (Pl. ii, fig. 18). The triangular median plate is well developed, approximately equilateral. Antennae (Pl. ii, fig. 19) small and rudimentary: truncate: with a few short stout hairs at the apex of each: joints obscure, apparently two or three. Limbs rudimentary; each consisting of a short stout claw on a broad chitinous base (Pl. ii, fig. 20). Paired pores very numerous and crowded: of two sizes: arranged more or less concentrically in a series of whorls on the dorsum (Pl. ii, fig. 21). On the terminal segments, the larger paired pores occur only on the lateral margins. There are four groups of small thick-rimmed simple circular pores on the marginal area, opposite the stigmatic openings. Cribriform plates (Pl. ii, fig. 22) conspicuous; two groups on each side of a median line, one to three in anterior groups, three to six in posterior groups: each plate concave, with a dense patch of pores in the centre. Anal ring with eight stout hairs: two similar hairs on the dorsal lip of the anal aperture. Length, 1.25 to 1.75 mm. Greatest breadth, 1 to 1.5 mm.

Adult male and early stages not observed.

Habitat.—On *Helicteres isora*: Saharampur, N.W.P., India. Reported by E. P. Stebbing to be a pest of some importance in the forests of the Siwaliks.

Differs from *Cerococcus paradoxus* in the arrangement of the paired dorsal pores which—in that species—are less numerous and arranged in transverse bands. Distinguishable from *hibisci* in the coarser and denser tomentum of the female test.

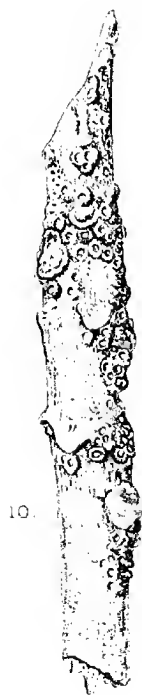
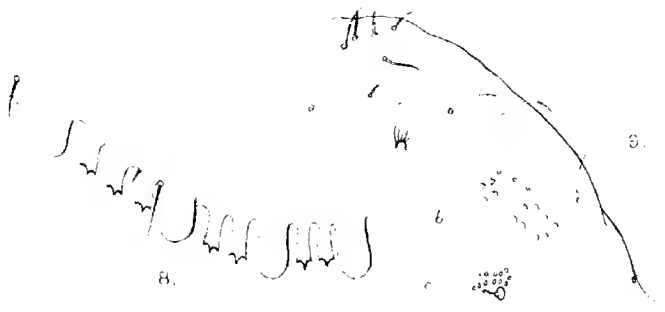
***Lecanium imbricans*, Green.**

Lecanium imbricans, Green: Ind. Mus. Notes, 1903, v, p. 94.

Hemilecanium theobromae, Newst.: Journ. Econ. Biol., 1908, iii, No. 2, p. 39.

Having recently received fresh material of *Lec. imbricans*, including specimens of the young larvae, I have now convinced





PECIES OF COCCIDS

myself that it is co-specific with *Hemilecanium theobromae* of Newstead. All the characters are identical, including the remarkable groups of glandular pores found in all stages of the insect from the newly-hatched larva upwards. It may very possibly be considered that these characters warrant the exclusion of the species from the genus *Lecanium*, in which case Prof. Newstead's generic name may be adopted. The insect would then be known as *Hemilecanium imbricans* (Green).

Mr. R. D. Anstead, Scientific Adviser to the United Planters Association of Southern India, gives me the following particulars of the pest, as it occurs in India.

"I found it on three neighbouring estates in South Mysore, in the district of Balur. It was attacking the following trees:—*Ficus glomerata*, *Ficus infectoria*, and *Cedrela toona* (Red Cedar).

The effect is to cover the underside of the branches, even the big primaries and form a dense silvery white mass. This rapidly kills the branches attacked and—finally—the whole tree.

The scale is accompanied by a sooty fungus, which grows in great quantities on the plants below and this rapidly kills out coffee. I could find no scale on the coffee or on any other plant except the trees named above. At present the infected branches are cut off at this time (September to November) and simply thrown down. I have advised that they should be burned and the apparently cleaned tree whitewashed. All spraying is quite impracticable under the local conditions."

EXPLANATION OF PLATES I AND II.

Illustrating Mr. E. Ernest Green's paper "On some Coccid Pests of Economic Importance."

PLATE I.

Aspidiotus oceanica (Lind.)

Fig. 1.—Part of Coconut leaf, with insects *in situ*, nat. size.

Fig. 2.—Puparium of ♀, dorsal view. × 20.

Fig. 3.— " " " ventral view. × 20.

Fig. 4.— " " ♂, dorsal view. × 20.

Fig. 5.— " " " ventral view. × 20.

Fig. 6.—Adult ♀ insect, optical section. × 30.

Fig. 7.—Pygidium of adult ♀, optical section. × 250.

Fig. 8.—Terminal margin of pygidium. × 1,000.

Fig. 9.—Antero-lateral area of adult ♀, showing marginal hairs, antenna (a), group of papillae (b), and anterior spiracle (c). × 100.

Asterolecanium fustulans var. *seychellarum*, nov.

Fig. 10.—Portion of *Hevea* stem, with insects in situ, nat. size.

Fig. 11.—Test of adult ♀, dorsal view. × 35.

Fig. 12.—Adult ♀ insect, optical section. × 60.

PLATE II.

Fig. 13.—Posterior extremity of adult ♀, optical section. × 450.

Fig. 14.—Portion of marginal area, showing relative sizes of the marginal (a) and discal (b) paired pores. × 450.

Cerococcus indicus, n.sp.

Fig. 15.—Insects on branch, nat. size.

Fig. 16.—Adult ♀, optical section. × 30.

Fig. 17.—Terminal segments of adult ♀, optical section. × 250

Fig. 18.—Extremity of older sample. × 250.

Fig. 19.—Antenna. × 450.

Fig. 20.—Rudimentary limb. × 450.

Fig. 21.—Paired pores from dorsum, showing whorl formation. × 450.

Fig. 22.—Cribriform plates. × 450.

SOME OBSERVATIONS ON THE EGGS OF THE HORSE
BOT FLY; *GASTROPHILUS EQUI* (FABR.)

By

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.

WITH 3 FIGURES.

ALTHOUGH there is a voluminous literature treating of the structure and life-history of the Horse Bot Fly, *Gastrophilus equi* (Fabr.), I have been unable to find a single correct figure of the egg of this insect.

Many authors do not figure it at all, whilst those that do, represent it in an incorrect manner.

The most recent description I know of is that by Froggatt,¹ who states: "The eggs are dull light-brown to dirty white in colour, elongate oval in form, somewhat pointed, and broadest at the apex." His figures (Figs. 3 and 4) show a somewhat spindle-shaped egg, with strong *longitudinal* striation and an operculum lying at a right angle to the long axis of the egg, and with the broad end uppermost.

Osborn² states: "They are about one-sixteenth of an inch in length, and taper a little towards each end, though the attached end is the smaller. The outer end is provided with a little cap (operculum), which is set quite obliquely to the axis of the egg, though some authors represent it as cutting the egg square off at the end."

Osborn's figures (Fig. 37 *a* and *b*) are both upside down.

Neumann's³ account reads as follows: "The ova of the *Gastrophilus* of the Horse are yellowish-white in colour and conical in shape, being 1.25 mm. long; they are transversely striated, and provided at the larger extremity with an operculum which is obliquely truncated. They adhere to the hairs by their narrow end, in the same manner as the 'nits' of the Louse, by means of a viscid matter that is deposited with them; their wide end remains pendent."

The idea that the eggs were conical at one end and adhered to

¹ N.S.W. Dept. of Agric., Miscell. Pub., No. 432, March, 1908, p. 3.

² U.S. Dept. Agric., Div. of Entom., Bull. No. 5, new series, 1896, p. 79.

³ A Treatise on the Parasitic Diseases of the Domesticated Animals. English Trans. 2nd ed. 1905, p. 293.

[JOURN. ECON. BIOL., March, 1910, vol. v, No. 1.]

the hairs of the horse by a sticky secretion seems to have been copied from Bracy Clark's account¹ by practically all succeeding writers.

No mention is made of the egg by Schroeder van der Kolk² in his classical account of the anatomy of this insect.



Fig. 1.

Fig. 1.—Egg of *Gastrophilus equi* (Fabr.), attached to hair by lip-like valves.



Fig. 3.

Fig. 3.—Operculum, seen from above.



Fig. 2.

A careful examination of the egg at once proves the incorrectness of the above accounts, and it seems strange that when the eggs of other species of *Oestridae* have been so carefully figured and

¹ Trans. Linn. Soc., 1797, vol. iii.

² Nieuwe Verhandl. K. Nederl. Inst., Amsterdam, 1845, T. 9, pp. 1-155, pls. i-xiii.

described, no one should have thought it worth while to carefully examine those of the species under consideration.

I therefore propose to here give a short description of the egg, together with figures made from recently deposited specimens.

When deposited the eggs are almost white in colour, afterwards turning to a light yellow or a dirty white. They show a well-marked series of transversely raised ridges situated at about equal distance apart, here and there having a wavy or sinuous character and occasionally merging into one another.

In length they average 1.25 mm. and taper to a blunt point at one end and are obliquely truncate at the other. This the anterior or pendent end is covered by a cap or operculum, which lies obliquely to the long axis of the egg and not at a right angle.

Like that of *Hypoderma* the egg may be said to consist of two parts, viz., the egg proper and a pair of lips or valves, which close round the hair and secure the attachment of the egg. The wavy striation is continuous over these lip-like bodies.

If the egg is detached from the hair the margins of these lips usually adhere to it and a very definite attachment surface can be made out on the egg. (Fig. 2).

The peripheral margin of the operculum extends slightly over the edge of the opening of the egg, and so when the slightest friction is brought to bear upon the ripe egg it is easily torn off.

When newly deposited, what I have termed the attachment surface and the inside of the two lateral extensions are covered with a sticky matter which soon dries, at the same time the lateral extensions close around the hair and almost meet together, thus very firmly securing the egg to the hair.

In spite of many statements to the contrary it is most unusual for the eggs to be detached by the action of the horse's tongue. What actually takes place is, the operculum is brushed off and the larva within is carried by the tongue to the horse's mouth.

The empty eggs may be found weeks after, firmly attached to the hairs on the shoulders, forelegs, mane, etc.

The operculum is convex above and marked with a honeycomb pattern (Fig. 3). I hope to give some further particulars in a later paper respecting this.

EXPERIMENTS WITH THE EGGS.

The various statements respecting the hatching of the eggs are very contradictory and in not a few cases inaccurate.

Very briefly I wish to set forth the accounts given by different observers.

Verrill¹ states that "the eggs contain more or less perfectly developed larvae when laid; and when they are mature or have been a few days attached to the hair, they burst open and allow the young to escape almost instantaneously, when moistened. Thus when the horse licks itself, or its companions, the moisture hatches the eggs, and the young larvae are transferred to the mouth by the tongue or lips.

Froggatt² states "These eggs are generally deposited on the jaw, shoulders, or flanks of the animal, from whence, through the animal licking itself, they are conveyed to the lips and mouth, the warmth dissolving the glaucous secretion and hatching the enclosed maggot, thus enabling it to crawl out into the throat."

Neither of these statements are borne out by the observations here recorded.

Bracy Clark's account,³ although given upwards of a hundred years earlier, is much more correct. He writes: "The eggs thus deposited I at first supposed were loosened from the hairs by the moisture of the tongue, aided by its roughness, and were conveyed to the stomach, where they were hatched; but on more minute search I do not find this to be the case, or at least only by accident; for when they have remained on the hairs for four or five days they become ripe, after which the slightest application of warmth and moisture is sufficient to bring forth in an instant the latent larva. At this time, if the tongue of the horse touches the egg, its operculum is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches; in which case its existence to the full growth is more precarious, and certainly not so agreeable, as it is exposed to the bitterness of the bile.

I have often, with a pair of scissors, clipped off some hairs with the eggs on them from the horse, and on placing them in the hand, moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the larva would not appear, though held in the hand, under the same circumstances, for several hours; a sufficient proof that the eggs themselves are not conveyed to the stomach. . . . The eggs, in the first place, when ripe, often hatch themselves, and the larva, without a nidus, crawls about till

¹The External and Internal Parasites of Man and Domestic Animals. Hartford, Conn., 1870.

²*Op. cit.*, p. 3.

³*Op. cit.*

it dies; others are washed off by water, or are hatched by the sun and moisture, thus applied together."

Other writers state that the eggs hatch after a time, and the horse, feeling the irritation of the larvae creeping over the skin, licks itself and thus conveys them to the mouth.

Finally, Osborn¹ has recorded a series of most interesting experiments. He writes: "Eggs collected from a horse while flies were depositing, and therefore probably not long laid, were opened at different times by rubbing them with a moistened finger, simulating as nearly as possible to the action of the tongue in licking the body. While the larvae appeared to be fully formed during the first three or four days after deposition, the eggs hatched with difficulty and the larvae seemed inactive, and all larvae that were freed in this manner up to the tenth day were hatched with difficulty, though the larvae at the end of this time were becoming fairly active.

Four weeks after hatching the eggs opened with the slightest touch of a wet finger, and the larvae adhering to the finger were very active, though in some cases they were inactive and apparently dead. About five weeks after collecting the eggs nearly all gave only inactive or dead larvae, though opened with ease on being touched by the finger, and in forty days after collecting no living larvae could be found in the remaining eggs, except one which had succeeded in pushing off the cap of the egg and partially emerging.

In view of these results, I concluded:—

(1) That the eggs of the horse bot fly do not hatch, except by the assistance of the horse's tongue.

(2) That hatching does not ordinarily occur within ten or twelve days and possibly longer, or if during this period, only on very continuous and active licking by the horse.

(3) That the hatching of the larvae takes place most readily during the third to fifth week after deposition.

(4) That the majority of the larvae lose their vitality after thirty-five to forty days.

(5) That the larvae may retain their vitality and show great activity upon hatching as late as thirty-nine days after the eggs were deposited.

(6) That it is possible, though not normal, for eggs to hatch without moisture or friction.

(7) That in view of these results, the scraping off of the eggs, or their removal or destruction by means of washes will be effective, even if not used oftener than once in two weeks during the period

¹*Op. cit.*

of egg deposition, and, probably, that a single removal of the eggs after the period of egg deposition has passed, will prevent the great majority of bots from gaining access to the stomach, or at least so large a proportion that little injury is likely to occur.

Wishing to know still more definitely the period of most ready hatching, and the effect of different washes for treatment, I suggested to a veterinary student, Mr. Harry Shanks, a careful series of observations, which were carried through during the summer of 1894.

From this study, which was made under my direction, and so that I had frequent opportunity to note progress, a number of points were gained, which are worth adding to the above record. Three hundred eggs were collected from a horse which had been previously freed from eggs, so that the exact date of deposition was assured. The eggs were tested every day.

On the day of collection (first day) the eggs appeared immature. One day later eight eggs opened by picking the operculum off, showed three larvae with slight movement, and five immovable. On the third day a half-hour of friction failed to hatch eggs, but the larvae when freed by picking off the operculum showed two, slight movement; one, no movement, and one sufficient movement to get out of the opened shell.

On the fourth day the larvae in eleven eggs were all active, but had to be freed by picking off the operculum; the same was true up to the seventh day, the only difference being noted in greater maturity and size of larvae.

On the ninth day, or when the larvae were eight days from deposition, one larva was freed by seventeen minutes' rubbing with wet finger, another in twenty-two minutes; on the tenth day two others, one in fourteen and the other in eight minutes; and on the eleventh day several were hatched, the time varying from two to five minutes of subjection to the saliva and friction. On the twelfth day it required but one or two minutes, and on the thirteenth eggs would hatch in fifteen to thirty seconds. On the fourteenth day a number of eggs were tried, about one-third of which hatched almost immediately upon being touched with the moist finger, the others in from five to eight seconds. On the fifteenth day all eggs seemed fully mature, and probably nine-tenths would have hatched at once upon being touched by a horse's tongue in the ordinary motion of licking. From the sixteenth day to the twenty-second the eggs would open with a touch of the finger, but the larvae would not adhere except with moisture. On the twenty-third day the first dead larva was noted, and a day later four out of eleven eggs opened had dead

larvae. On the twenty-fourth day all of the eggs not previously opened were examined with a lens, and only one showed the cap removed, the larva being partly out but dead. The hatching of but one egg out of three hundred seems to me to establish pretty fully my former opinion, that the eggs require moisture or friction for the release of the young.

On the twenty-fifth day, out of ten eggs three contained dead larvae, five could move slightly, and two were quite active. On the twenty-sixth day caps were removed from thirty-five eggs, twenty-seven larvae being dead, seven were capable of slight movement, and one was active enough to escape from the shell.

On the twenty-seventh day out of forty-three eggs opened only one larva was alive, and on the twenty-eighth day only one out of sixty-five, and on the twenty-ninth day all the remaining eggs, one hundred and three, showed only dead larvae.

The results of this study it will be seen, confirm in the main the conclusion of the former observations, the principal difference lying in the fact that all the larvae were dead at a somewhat earlier period. Of course it could not be said that of the eggs opened in the earlier days none would have survived longer than four weeks, but considering the number used and that one-third of them were kept the full four weeks and two-thirds nearly that long before being opened, the presumption is strong that that is the full normal period of survival.

It is safe, I think, to sum up the matter by saying that the eggs normally require friction and moisture to permit of their hatching and transfer to the horse's mouth, that hatching occurs with difficulty before the tenth day, and most readily after the fourteenth day, and that they lose vitality at a period varying between the twenty-eighth and fortieth days, the bulk not surviving more than four weeks. This gives a solid foundation upon which to base recommendations as to the time when eggs must be destroyed."

Before describing my own experiments, I should like very briefly to deal with the views advanced by the above-mentioned writers.

Verrill's statement that larvae are present in the egg when laid I consider not entirely accurate. It is possible, indeed probable, if after the fertilization of the eggs dull weather follows and the ova are retained for some time within the parent, that this may be the case, as I have recorded for *Oestrus ovis*, Linn.,¹ and further, I have an egg taken from a torpid female, in which a fairly well-developed larva is present, still in the ordinary course of nature I think we are

¹ Journ. Econ. Biology, 1906, vol. 1, pp. 72, 73.

not warranted in stating that the eggs contain larvae when laid.

The further statement that "moisture hatches the eggs" is scarcely correct in the light of Osborn's experiments and those recorded here.

Froggatt's statements that the eggs are carried to the mouth and hatch there is certainly wrong, and that of Bracy Clark's that the "warmth and moisture is sufficient to bring forth in an instant the latent larva," I am unable to verify.

A view largely held by farmers and others that the larvae hatch and creep about the skin, is also without any supporting evidence.

So far as I can learn Osborn (*op. cit.*) was the first to definitely establish the fact that the eggs were not taken into the horse's mouth, and that in addition they required friction in addition to warmth and moisture. In his experiments, however, he does not seem to have taken into consideration the possibility of newly-laid eggs containing larvae.

The object, therefore, of the experiments here recorded is to verify or otherwise those made by Osborn.

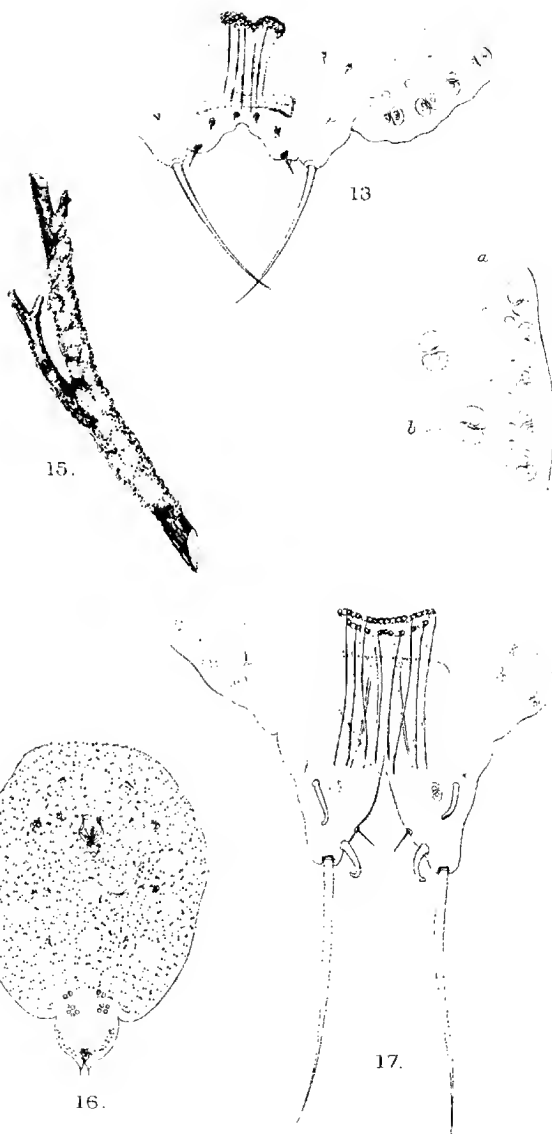
A. The first batch of eggs were taken a few hours after being deposited.

1. A number of hairs with eggs attached were placed in a glass jar in which a damp sponge was suspended from the rim of the jar, but not in contact with any of the eggs. A temperature of 80° to 85° F. was maintained by means of a water bath. On the twenty-third day two eggs hatched and were removed, the following day one hatched and twenty-two remained unhatched on the fortieth day. When examined the larvae were all found to be dead.

2. The above experiment was also tried with eggs from batch A, leaving out the damp sponge. On the twenty-second day two eggs hatched, and the remainder were kept under observation for nearly five weeks, but no further hatchings took place.

3. A third experiment was made with some of the eggs of batch A as follows: a bundle of the hairs were tied together and tied to a piece of canvas tacked on to a piece of wood, which was allowed to hang outside exposed to the rain and sun. There were fifty-seven eggs, and at the end of twenty-one days only one egg was observed to have lost its operculum. They were examined daily to the end of the eighth week, when fifty-four eggs remained unhatched.

4. A fourth lot of eggs, similar to batch A, and may therefore be included here, were tested by first fixing the hairs to a piece of cloth and carefully wiped over with a piece of close, damp sponge. One half of the eggs were left untouched until the thirtieth day. On the twelfth day five eggs hatched, and the larvae adhered to the



E. E. Green, Detroit, Mich.

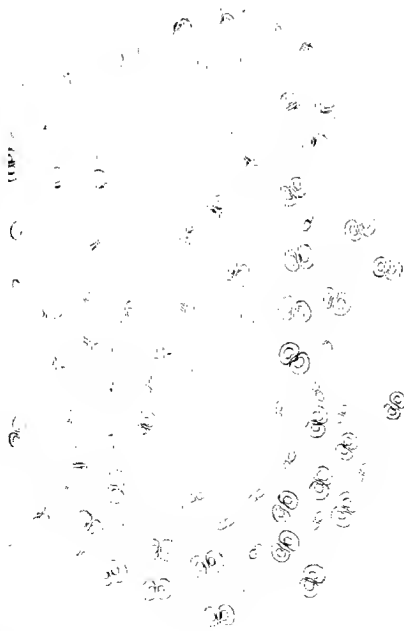
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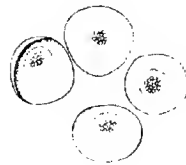
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21



20.



22.

sponge, on the fourteenth day fourteen hatched, on the sixteenth day twenty, on the eighteenth day nineteen, on the twentieth day twenty, on the twenty-fourth day four, and on the twenty-eighth day one, a total of 83. All the empty egg-shells were still adhering to the hairs and there remained eleven dead eggs on the thirty-sixth day.

On the twenty-fourth day the second half of the eggs were treated and three hatched, on the twenty-fifth day two, and on the twenty-seventh day one. The method of carefully wiping over with the sponge was continued until the thirty-sixth day, but no further hatchings took place.

SUMMARY.

From the foregoing observations it is concluded that :---

1. The egg of *Gastrophilus equi* (Fabr.), is provided with a pair of lip-like valves, by means of which it is firmly attached to the hair.
2. After the larva has escaped the egg-shell adheres for some considerable time to the hair.
3. The eggs are not taken into the mouth as stated by Froggatt.
4. My experiments confirm and supplement those of Osborn, although the actual dates differ somewhat, thus the largest number of eggs hatched from the sixteenth to the twentieth day, and none hatched after the thirty-sixth day.
5. Without moisture or friction very few eggs hatch.

It is hoped to repeat these experiments and others during the coming summer, when further details will be given.

ON TWO NEW SPECIES OF AFRICAN COCCIDAE.

By

ROBERT NEWSTEAD, M.Sc., A.L.S., Etc.

WITH 2 FIGURES.

THE two interesting Coccids herein described were collected by the Revd. Father P. Kohll. Missionhaus, Sittard. I have pleasure in expressing my indebtedness to him for giving me the opportunity of examining the material.

Hemilecanium recurvatum, n.sp.

Fig. A.

Female, adult. Piceous, with a large central yellowish-brown area, the extreme margins being also slightly paler than the darker

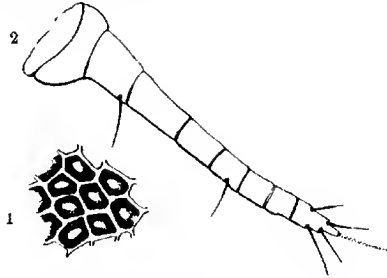


Fig. A.—*Hemilecanium recurvatum*, n.sp. 1.—Derm cells.
2.—Antenna.

portions of the chitine. Short ovate or sub-circular, thin and flat (transversely), but *strongly recurved at both extremities*; median area with a very large, deep, and more or less circular depression in the centre of which are placed the anal plates. This depression is rendered all the more conspicuous by its pale colour due to the thinness of the integument which in the dry specimens becomes almost transparent by transmitted light, the rest of the integument very dense. Derm cells (Fig. A, 1) rather large, irregularly polygonal, angles rounded, each with a clear central or sub-central area. Anal

lobes large; apex with many fine spinose hairs; a faint short line extends from these towards the anal margin, but the anal cleft is completely fused as in the type (*H. theobromae*, Newst.¹). Antennae (Fig. A, 2) of 8 segments; the third being slightly longer than the second; formula 3, 2, 8, 4, 1 (3, 6, 7). Legs short or a very little longer than the antenna. Length, 1.50-2 mm.

Larva (extracted from the body of the parent) not differing apparently from typical *Lecanium*; but the specimens have not restored sufficiently well in the potash to enable one to trace all the anatomical details with any degree of accuracy. The anal lobes are, however, decidedly large with a distinct but finely reticulated surface. Antennae of six segments, of which the third is much the longest. The derm cells seen in *H. theobromae* are not traceable, and owing to the condition of the specimens it is impossible to say whether they exist or not.

Easily distinguishable by its small size, the large central depression and the recurved character of the body.

Habitat.—"Trouvés dans les branches creuses de *Plectronia Laurentii*, De Wild; Cultivés par les *Cremastogaster*. Romée près de Stanleyville, Haut Congo." Nos. 7 and 9 Coll. P. H. Kohll.

***Stictococcus formicarius*, n.sp.**

Fig. B.

Female, adult. Pale castaneous; usually oval, but some examples are decidedly narrowed posteriorly; dorsum flat or slightly concave with deep gland pits and irregular transverse grooves becoming more pronounced at the bluntly but strongly crenulated margin; sides sub-vertical and deep; ventral margin distinctly carinated. The deep crenulations of the upper margin are interrupted in the centre of the frontal area, where there are two distinct and rather widely separated eye-like tubercles; these latter, together with the other sculpturings of the dorsal surface, give the insect a striking resemblance to a miniature trilobite.

Antennae (Fig. B, 1) short, equal in length to the tibio-tarsal segments together; third and fifth segments the longest; apical segment with several long and very stout setae. Legs short, stout; digitules of the claw unequal; one is broad and flat, apparently of equal width throughout, with the apex suddenly recurved and faintly dilated; the second is normal with a faint apical knob. Tarsal digitules normal. Marginal spines (Fig. B, 2) of three types: a broad obtuse form (a) arranged in more or less regular sequence

¹ Journ. Econ. Biol., 1908, vol. iii, 2, p. 39, fig.

all round the body; a series of slender straight spines (*b*) slightly inset; and at long and irregular intervals there are also a few large serrated ones (*c*), and at still greater intervals single long bristles. Epidermis of the dorsum with numerous large gland tracts; and each of the large, blunt, prominences forming the crenulations of the upper margin are furnished with a single large tubular organ having a broadly dilated and trumpet-shaped orifice (Fig. B, 3); between the large gland tracts are numerous spinnerets and minute spines.



Fig. B.—*Stictococcus formicarius*, n.sp. 1.—Antenna. 2.—Marginal spines, *a*, broad obtuse form, *b*, slender straight form, *c*, serrated form. 3.—Orifice of gland. 4.—Marginal spines of larva, *d*, one of the long bilateral bristles. 5.—Tarsus.

Venter with few gland tracts, spinnerets and minute spines. Anal orifice normal. Length, 3 mm.

Larva (extracted from the body of the parent), short ovate; dorsum with four¹ longitudinal rows of strong spines, broadly dilated and irregularly serrated anteriorly. Margin (Fig. B, 4), with a series of spines similar to those in the adult female, but the long

¹There may be more; but it is impossible to determine the exact number owing to the somewhat crumpled condition of the specimens.

bilateral bristles (*d*) are in length almost equal to the width of the body; and the median anal pair are of still greater length. *Antennae*, short and apparently composed of five segments, but the articulations are faint and not clearly defined. Legs short setose; tarsus (Fig. B, 5) nearly twice the length of the tibia; upper tarsal digitule bristle-like; lower digitules broadly dilated, with many fine radiating striae and a truncate extremity. Anal orifice, with six long setae; and the inner and upper half of the orifice with a fringe of fine hairs. Mentum doubtfully monomeric.

Habitat.—"Trouvés dans les branches creuses de *Barteria fistulosa*, Mast., cultivés par les fourmis *Sima spininoda*, Andre. Trouvés à Romée près de Stanleyville, Haut Congo." "No. 6" Coll. P. Hermann Kohll.

The habitat of this insect, apart from its association with the *Cremastogaster*, is very remarkable. It is very rarely that Coccids locate themselves in the hollow stems of their food-plants. Each female also forms a marked depression or pit which is distinctly traceable on the outer surface of the branch as a slightly raised and irregular prominence, more especially so on those branches in which the woody tissues are relatively thin.

In the female the superficial resemblance to *Stictococcus sjostedti*, Ckll., is very striking indeed, but it may at once be distinguished from this species by the marked character of the marginal spines, and the presence of the tubercles at the anterior margin of the body. In the larva there is also a still more marked difference: *S. sjostedti* having a fringe of very long hair-like bristles at the margin, which in *S. formicarius* are almost entirely replaced by the curiously shaped spines similar to those in the adult female. Three additional examples ("Nos. 5 and 8") of a *Stictococcus*, undoubtedly referable to *S. formicarius*, were also collected by Father P. Hermann Kohll. These, however, differ from the type lot by being piceous in colour, much more convex dorsally, and the crenulations at the margin are replaced by a series of minute and very widely separated angular projections. These examples are, I assume, much older individuals than those found in the hollow stems of the *Barteria*; though it is noteworthy that the co-types (No. 6) all contained fully developed larvae. The data accompanying these three specimens is as follows:—

"No. 5. Trouvés dans les branches creuses de *Cuviera angolensis*, Welw., cultivés par les fourmis *Cremastogaster africana* sub-sp; *laurentii*, For. Trouvés à Romée près de Stanleyville, Haut Congo."

"No. 8. Trouvés dans les branches creuses *Cuviera angolensis*, Welw., cultivés par des *Cremastogaster*. Congo." Two females. One of the examples in this lot contained a minute Lepidopterous larva which has partly destroyed its host. *S. sjostedti* is also preyed upon by a similar larva, which, however, builds for itself a little silken cocoon into which it weaves fragments of the skin of its host's body, so cleverly wrought as to appear like little convex patches of glistening brown mosaic when examined under a low magnifying power.

*School of Tropical Medicine,
The University.*

31st January, 1910.

RESEARCHES ON FUNGI.¹

IN order that the precise scope of the present work may be indicated it is necessary to append the qualifying title, which is as follows: "An account of the production, liberation, and dispersion of the spores of Hymenomycetes, treated botanically and physically, also some observations upon the discharge and dispersion of the spores of Ascomycetes and Pilobolus." The text, then, deals with the dissemination of basidiospores and sporangial spores of certain types. And at the outset it may be stated that the book gives evidence of much tireless and careful observation on the part of the author, and contains no inconsiderable amount of new information.

Chapters I.-V. deal largely with the coarser anatomical and physiological characters of the fructifications of Hymenomycetes from the point of view of arrangements for facilitating the dispersal of spores. It is pointed out that the freshly freed basidiospores are adhesive, so that provision must be made for them to fall freely and vertically from the more or less confined spaces in which they are produced.

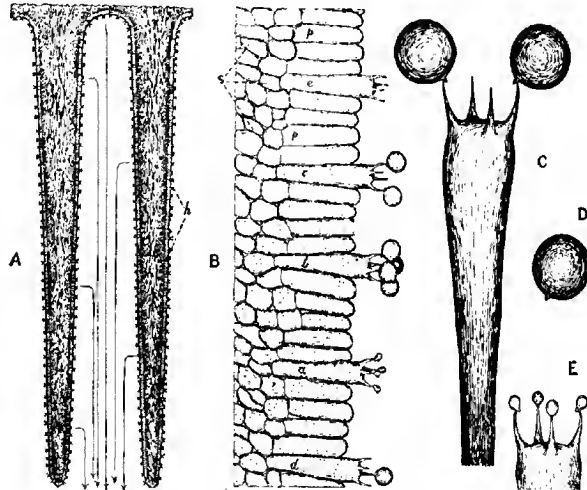
Among the varied subjects discussed are: the effect of light upon the vitality of spores; the production of gills and so forth as a means of increasing the surface and consequently the prolific power, with due economy of somatic material; the minimum distance apart of opposed hymenial surfaces permitting the violently projected spores to fall freely; structural and physiological devices for maintaining the hymenium-lined spaces in a vertical position under varying surroundings.

The remaining chapters, which include the larger part of the observations that are novel in essence, deal with the finer details of the liberation, fall, and dispersal of the basidiospores. The author describes his method of viewing falling spores by the aid of a beam of light. He gives records of the length of the period during which the fructification of various species sheds spores.

¹ *Researches on Fungi, an account of the Production, Liberation, and Dispersion of the Spores of Hymenomycetes treated Botanically and Physically, also some Observations upon the Discharge and Dispersion of the Spores of Ascomycetes and of Pilobolus.* Pp. xi + 286, pls. i-v, and 83 text figs. London: Longmans, Green & Co., 1909. Price 12s 6d. oct.

[Journ. Econ. Biol., March, 1910, vol. v, No. 1.]

Falk's conclusion that the setting free of the basidiospores in an active vital process is experimentally confirmed. The interesting information is given that the fructifications of certain Hymenomyces may be dried up, with the result that the shedding of the spores is arrested and kept in a living but desiccated condition for years, so that when once more supplied with moisture they recommence to shed spores. Thus a class of "xerophytic" fungi is recognized.

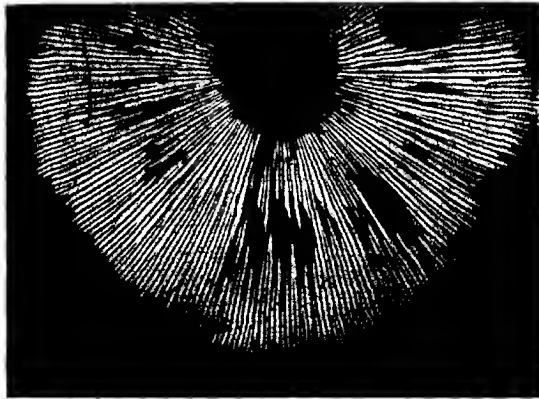


Amanitopsis vaginata.—Relations of the spores to the fruit-body. A, transverse section through two gills showing the hymenium, *h*, from which basidia are projecting. The arrows indicate the paths of spores which, after discharge from their basidia, have fallen in still air. Magnification, 15. B, vertical section through the hymenium and subhymenium. *p*, paraphyses; *a-e*, basidia; *a*, with rudimentary spores; *b*, with ripe spores; *c*, with two spores discharged; *d*, with three spores discharged; *e*, with all the spores discharged; *s*, the subhymenium. Magnification, 370. C, isolated basidium with two spores discharged showing mode of attachment of spores to their sterigmata. Magnification, 1110. D, discharged spore. Magnification, 1110. E, basidium with rudimentary spores. Magnification, 1110.

En passant it may be remarked that it would be well to restrict the term xerophytic to plants having permanent anatomical devices enabling them to resist desiccation: these fungi cannot be termed xerophytes until such devices have been demonstrated. But Professor Buller does describe one interesting case—that of *Schizophyllum commune*—in which there is a reversible change of

form of the sporophore under differing conditions of drought and moisture, of such a kind as to recall the temporary xeromorphy of grass-leaves that "roll up" when exposed to drought.

Professor Buller confirms Brefeld as to the fact that the spores are violently projected from the basidium, but he supplies a correction important to the comprehension of the mechanism, by pointing out that the four spores of the basidium are shot forth successively, not simultaneously. He concludes that the violent action is not due to the opening of the basidium and the consequent liberation of hydrostatic pressure with a "squirting discharge," but is more pro-



Spore-deposit produced in about twenty hours from a pileus of *Lepiota rachodes*. (The central parts of some of the gills were in contact with the paper: hence slight disturbances to the regularity of the deposit.) Natural size.

bably caused by a sudden splitting of the common wall between the sterigma and the spore into two separate layers.

The author endeavoured to test the truth of Stokes' law relating to the velocity of fall of microscopic spheres, but his results exceeded the value calculated according to Stokes' formula by nearly fifty per cent. Professor Buller observed that each individual spore showed variation in velocity during its fall, and in particular exhibited a final decrease which was more marked in dry than in saturated air. According to Stokes' formula the final velocity varies distinctly as the density and the square of the radius of the spherule; and Professor Buller attributes the ultimate decrease in velocity to decreased size of the spore as it parts with water during

its descent. (In explaining this loss by evaporation Professor Buller makes the extraordinary statement: "One must remember that a spore has an enormous surface compared with its mass . . .") The difficulty of testing Stokes' formula is evident when it is remembered that the spore should be spherical, and should be measured

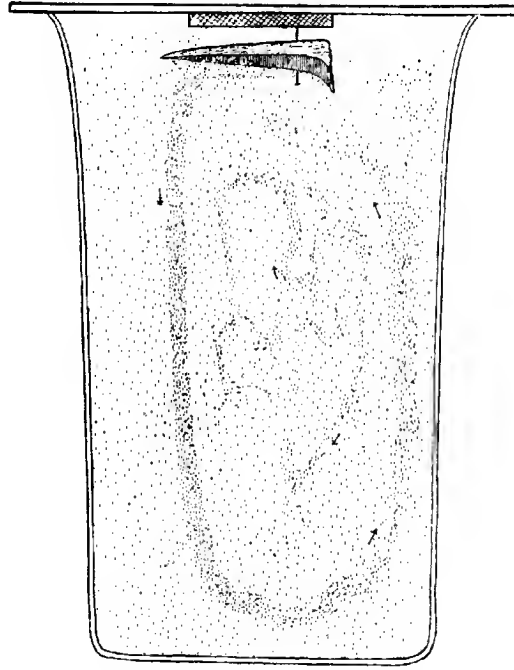


Diagram illustrating the discharge of spores from a fruit-body of *Polystictus versicolor* as seen by the beam-of-light method. The fruit-body is pinned in its natural position to a piece of cork attached to a circular glass cover placed upon a beaker. A stream of spores is carried round within the beaker very slowly by convection currents and gradually breaks up so that the spores become scattered fairly uniformly. Reduced to about $\frac{2}{3}$.

when just ready to fall from the basidium (not in water) and exactly at the conclusion of its measured flight, and its surface should be smooth.

But falling basidiospores are also liable to undergo change of shape, and Professor Buller mentions that the descending and dry-

ing mushroom spores acquire a boat-shape. By the assumption that these buckle up during their descent, he explains that the mushroom is exceptional in showing a final acceleration after the retardation, in the rate of fall of the spores. This acquisition of a semi-concave form on the part of drying basidiospores is, I believe, a very widespread phenomenon (though it may escape notice because the observer's breath is sufficient to restore the convex form, at least in some cases), and I cannot help regarding it as more probable that



The liberation of spores of *Coprinus comatus*. The fruit-body was gathered in a field and then set in a vertical position under a bell-jar. As the pileus expanded below, spores began to fall. The black spore-deposit upon the paper around the base of the stipe was formed in the course of three hours. $1/3$ natural size.

the concavity is calculated to retard the rate of fall by causing the descending spore to act as a parachute.

In the excellent and detailed account of the spore dispersal of *Coprinus*, Professor Buller demonstrates that the spores are scattered by the wind and that the inky fluid (produced by autodigestion) takes no share in the process.

As indicating the range of subjects discussed and of original information provided, mention may be made of the pages dealing

with the part played by animals in transporting basidiospores, the rôle of fungus-eating slugs, which, it is pointed out, are not kept at bay by acrid juices nor deadly poisons such as muscarin.

Some neat observations and suggestive remarks on the mechanism of the ascus, the scattering of spores by animals, and a most useful summary of the contents of the whole volume, chapter by chapter, conclude a volume which is not only a notable and truly interesting contribution to a branch of fungology that has received but little attention, but is also a work calculated to excite further research in the same field.

PERCY GROOM.

REVIEWS.

Kirkaldy, G. W.—Catalogue of the Hemiptera (Heteroptera) with biological and anatomical references, lists of food plants and parasites, etc. Vol. i. *Cimicidae*. Pp. xl + 392. Berlin: Felix L. Dames, 1909.

Mr. Kirkaldy's work aims at being something more than a mere catalogue of names. As the title of the work well expresses it gives biological and anatomical references, lists of food plants, parasites, etc.

Volume i treats of the *Cimicidae* and is admirable in all details but one. We cannot understand why the author has departed from the long recognized method of giving the references under the actual genera, subgenera, etc. It is most confusing to find no reference on p. 118 to the sub-genus *Acrosternum*, and we have to turn back to p. 115 to the genus *Nezara* to find the reference there. This, to our mind, is a very serious drawback to the Catalogue, which in every other way has been carefully thought out and must, when complete, form an extremely valuable work, and one which no student of the Hemiptera can afford to be without.

The volume before us is well printed and on thin paper, and contains a mass of wonderfully valuable details.

W. E. C.

Knuth, Paul. Handbook of Flower Pollination. Translated by J. R. Ainsworth Davis. Vol. iii, pp. iv + 611, and 208 figs and 1 pl. Oxford: The Clarendon Press, 1909.

In the present volume the Angiospermae are completed as well as the Gynanospermae, and the systematic list of insect visitors is given. This latter, extending as it does over one hundred pages, will prove most useful.

The present volume is full of interest and presents a wealth of material for both the entomologist and botanist.

It has been no slight task to bring together the voluminous records here given, and the translator is to be congratulated on the able manner in which he has carried out his task.

Long, Harold C. Common Weeds of the Farm and Garden. In collaboration with John Percival. Pp. xviii + 451, 100 figs. London: Smith, Elder and Co., 1910. Price 6s. net.

A small handbook treating of our common weeds and their relationship to agriculture has long been needed, and Mr. Long has admirably supplied that need in the form of the excellent work before us.

Writing upon this same subject some years ago we drew attention to the fact, that whilst almost every country regards the neglect of weeds as dangerous, England is about the only one in which there are no laws concerning the matter.

Mr. Long deals very thoroughly with the whole subject, first pointing out what weeds are, and how they affect our crops and live-stock, and in this connection he shows how many species harbour injurious insects and fungi.

The different agencies by which weeds are distributed is clearly set forth, as also the general preventive and remedial measures. A systematic account of the weeds of arable and grass land is next given. Parasitic and poisonous weeds, those of ponds, rivers, and ditches, and lawns and drives, are all carefully described.

There is a clear account of the principles of seed testing which should prove very useful, whilst a most useful list is given of weeds and poisonous plants, in which scientific and common names are given, the soil, situation, time of flowering, method of propagation, and other details.

Finally we have a concise account of the legislation enforcing the destruction of noxious weeds in the chief agricultural countries of the world, which shows, as usual, in nearly all matters concerning agriculture, our own country is behind her Colonies and other countries.

It is a book every agriculturist and horticulturist may read with considerable profit, and if it spurs them on, as we hope it will, to demand the same protection as is afforded in other countries, the author may feel justly proud of his labours.

W. E. C.

Swanton, E. W.—*Fungi and How to Know Them*. Pp. xi + 210 and 48 pls. London: Methuen and Co., 1909. Price 6s. net.

The object of the present work, the author informs us, is to supply an introduction to the more advanced treatises on systematic mycology, and he has more than succeeded in his work.

After a general explanation of the development of fungi the author describes the various groups and illustrates the same by an excellent series of plates. Miss Spittal is to be complimented on the faithful rendering she has given of the different species.

We much regret that the author has omitted the names of the authors of the different species, thereby considerably reducing the value of his work.

There are a few passages which are not quite clear especially to the beginner, for which the work is primarily intended, and the author himself is frequently in error in regarding the fructification as the fungus.

On the whole the book appears to steer clear of the pitfalls that invariably waylay the popular writer, and will serve a useful purpose.

W. E. C.

Thimm, C. A.—Bibliography of Trypanosomiasis. Embracing original Papers published prior to April, 1909, and References to Works and Papers on Tsetse-Flies, especially *Glossina palpalis*, Rob.-Desv. Pp. iv + 228. London: Sleeping Sickness Bureau. 1909. Price 4s. net.

That the publication of a bibliography of trypanosomiasis, such as the one before us, will prove of great service there can be no doubt, and Mr. Thimm's labours can scarcely fail to meet with the appreciation of investigators in all parts of the world.

Nearly two thousand references are given under authors and the journals in which they have appeared, each reference carrying an index number.

From Dr. Bagshaw's preface we learn that a subject index is in course of preparation, in which the numbers to be consulted for the various subjects will be indicated.

Both the compiler and the Sleeping Sickness Bureau are to be congratulated on the publication of a very useful and excellent piece of work.

CURRENT LITERATURE.

I.—GENERAL SUBJECT.

- Forbes, S. A.**—The General Ecology of the Indian Corn Plant. *Amer. Nat.*, 1909, vol. xliii, pp. 286-301.
- Jack, R. J.**—The "Nurseries Ordinance, 1909." *Rhodesian Agric. Journ.*, 1909, vol. vii, pp. 806-816.
- Middleton, T. H.**—Annual Report of the Intelligence Division of the Board of Agriculture and Fisheries, for the year 1908, Pt. II, 1909, pp. 1-55.
- Wood, T. B.**—Heredity in Farm Animals. *Journ. Farmers' Club*, 1909 (Dec.), pp. 905-919.

II.—ANATOMY, PHYSIOLOGY, AND DEVELOPMENT.

- Berlese, Antonio.**—*Monographia dei Myrientomata*. Redia, 1909, vol. vi, pp. 1-182, *T. i-xvii e 14 fig.
- Cholodkovsky, N.**—Zur Kenntnis des weiblichen Geschlechtsapparates der Musciden. *Zeit. wiss. Insektenbiol.*, 1909, Bd. v, pp. 333-337, 8 fig.
- Del Guercio, G.**—Contribuzione alla conoscenza dei Laenidi italiani. Morfologia, sistematica, biologia generale e loro importanza economica. Redia, 1908, vol. v, pp. 173-359, T. ix-xx, e 33 fig.
- Shelford, R.**—Two remarkable forms of Mantid oothecae. *Trans. Entom. Soc. Lond.*, 1909, pp. 509-514, 3 figs.

III.—GENERAL AND SYSTEMATIC BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

- Austen, E. E.**—Note on the Suggested Possible Long Duration of the Life of *Glossina palpalis*. *Bull. Sleeping Sickness Bur.*, 1909, No. 12, pp. 456, 457.
- Bagnall, R. S.**—On two new Genera of Thysanoptera from Venezuela. *Journ. Linn. Soc. (Zool.)*, 1909, pp. 329-335, plt. 46.

The new genera and species are *Anactinothrips meinerti* and *Actinothrips longicornis*.

- Börner, Carl.**—Die Verwandlungen die Insekten. SB. Gessell. Naturf. Freunde, 1909, pp. 290-311, 10 figs.
- Börner, Carl.**—Über Chermesiden. vi. *Cholodkovskya, Aphrastasia* und *Gillettea*. *Zool. Anz.*, 1909, Bd. xxxiv, pp. 498-511, 7 figs.

- Börner, Carl.**—Über Chermesiden. vii. *Cnaphalodes lapponicus* (Chol.). Zool. Anz., 1909, Bd. xxxiv, pp. 554-560, 1 fig.
- Buffa, P.**—I Tisanotteri esotici esistenti nel Museo Civico di Storia Naturale di Genova. Redia, 1908, vol. v, pp. 157-172, Tav. viii.
- Cameron, P.**—On some Diplopteryga from the South-west of North America. Pomona Journ. Entom., 1909, vol. i, pp. 78-85.
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Many new species described, but without figures.
- Crawford, D. L.**—Some New Thysanoptera from Southern California, 1. Pomona Journ. Entom., 1909, vol. i, pp. 100-108, 31 figs.
The following are described as new *Ankothrips* (gen. nov.) *robustus*, *Aclothrips longiceps*, *Euthrips minutus*, Moul., var. *setosus*, *Phyllothrips fasciculata*, and *P. fasciculata* var. *stenoceps*.
- Crawford, D. L.**—Some Thysanoptera of Mexico and the South, 1. Ibid., pp. 109-119, 29 figs.
The following are described as new *Aclothrips vespiformis*, *Heterothrips decacornis*, *Chirothrips mexicana*, *Euthrips insularis*, Frank., var. *reticulata*, *Rhaphothrips* (gen. nov.) *peculiaris*.
- Crawford, D. L.**—Notes on Californian Thysanoptera. Ibid., pp. 120, 121.
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- Eltringham, H.**—An Account of some Experiments on the Edibility of certain Lepidopterous Larvae. Trans. Entom. Soc. Lond., 1909, pp. 471-478.
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- Griffini, A.**—Sulla "*Gryllacris rubinervosa*," Serville con appunti sul genere *Dibolona*, Brunner e sulle "*Gryllacris americana*." Redia, 1909, vol. vi, pp. 183-192.
- Hayhurst, P.**—Observations on Two Species of *Hyalopterus* (*Aphididae*). Journ. N.Y. Entom. Soc., 1909, vol. xvii, pp. 108-115, 1 pl.

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Hewitt, C. Gordon.—The Structure, Development and Bionomics of the House-fly, *Musca domestica*, Linn. Pt. III. Quart. Journ. Micros. Sci., 1909, vol. 54, pp. 347-414, plt. 22.

The author describes the bionomics of this pest, certain of its allies which may occur in houses, its parasites, and its relation to man, especially as the carrier of the bacilli of certain infectious diseases.

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Janet, Charles.—Sur l'ontogénèse de l'Insecte. Pp. 129, 4 figs. Limoges: Ducourtieux et Gout. 1909.

Kew, H. W.—Notes on the Irish False-Scorpions in the National Museum of Ireland. Irish Nat., 1909, vol. xviii, pp. 249, 250.

Linnaniemi, W. M. (Axelson).—Zur Kenntnis der Collembolenfauna der Halbinsel Kanin und Benachbarter gebiete. Acta Soc. F. et F. Fennica, 1909, pp. 3-17, map.

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Pierce, W. D.—Studies in North American Weevils. Proc. U.S. Nat. Mus., 1909, vol. 37, pp. 325-361.

Pierce, W. D.—A Monographic Revision of the Twisted Winged Insects comprising the Order Strepsiptera, Kirby. U.S. Nat. Mus., Bull. 60, 1909, pp. xii + 232, 15 pls, 3 text figs. and map.

In this very valuable revision the author emphasises the importance of a more intensive and extensive study of the Strepsiptera. He enters very fully into the history and systematic position, the biology, internal and external structure and classification, and gives a Check-list of the Order. There are a number of new genera and species described and a useful Host list given.

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- Silvestri, F.—Descrizione di una nuova famiglia di Diplopoda Cambaloiden del Tonkino. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iv, pp. 66-70, 5 figs.
Fam. *Pericumbalidae*, nov. *Pericumbala orientalis*, gen. et sp. nov.
- Trägårdh, Ivar.—Zur Kenntnis von *Phytomyza xylostei*, Klth., eine in *Lonicera symphoricarpos* minierende Fliege. Zeit. f. wiss. Insektenbiol., 1909, Bd. v, pp. 301-304, 11 fign.
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- Chittenden, F. H.—Some Insects Injurious to Truck Crops. U.S. Dept. Agric., Bur. of Entom., Bull. No. 82, Pt. ii, 1909, pp. 9-24, 6 figs.
The insects treated of are the parsnip leaf-miner (*Acidia fratria*, Lew.); the parsley stalk weevil (*Listronotus latiusculus*, Boh.); and the celery caterpillar (*Papilio polyxenes*, Fab.).
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- French, Jun. C.** The Tomato Weevil. (*Desiantha norica*, Lca.). Journ. Vict. Dept. Agric., 1909, vol. vii, p. 642, 10 figs.
- Forbes, S. A.** Twenty-fifth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Pp. xxiii + 124, 35 figs. and 3 pls. Illinois, 1909.
- An excellent report dealing with experiments with repellents against the Corn Root-aphis, the habits and behaviour of the Corn Field Ant, *Lasius niger americanus*, and the insect pests of Clover and Alfalfa.
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- Howard, L. O.** The Report of the Entomologist for 1909. U.S. Dept. Agric., Ann. Rpt., 1909, pp. 1-45.
- Hunter, S. J.** The Green Bug and its Enemies. A Study in Insect Parasitism. Bull. Univ. Kansas, 1909, vol. ix, No. 2, pp. ix + 221, pls. i-ix, figs. 1-65.
- The subject of this exhaustive memoir is *Toxoptera graminum*, the Southern grain aphid which is parasitised by a small hymenopterous insect *Lysiphlebus tritici*, Ashm.
- Professor Hunter has very thoroughly worked out the life-histories of both insects, and details a host of very valuable experimental work of great economic importance. Prof. P. A. Glenn adds an interesting paper on the influence of climate upon the pest and its parasite.
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- Sanderson, E. D., and A. D. Jackson.—The Oblique-banded Leafroller (*Archips rosaceana*, Harris). Ibid., pp. 391-403, plts. 15-18.
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- Webster, F. M.—The Chinch Bug. (*Blissus leucopterus*, Say). U.S. Dept. Agric., Bur. of Entom., Circ. No. 113, 1909, pp. 1-27, 8 figs.
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V.—FORESTRY.

- Adkin, B. W.—The Butterflies and Larger Moths affecting Forestry in Britain. Quart. Journ. For., 1909, vol. iv, pp. 9-30.

We learn from a foot-note that this essay was awarded a silver medal in 1908, presumably by the Royal English Arboricultural Society. It is a poor compilation containing one or two very serious errors, which should have been corrected by someone before being printed.

Hopkins, A. D.—Contributions toward a Monograph of the Scolytid Beetles. 1. The Genus *Dendroctonus*. U.S. Dept. Agric., Bur. of Entom., Tech. Ser., No. 17, pt. i, 1909, pp. xiii + 164, 8 pls. and 95 figs.

Dr. Hopkins' contributions to forest entomology have a world-wide interest and fame, and the present monograph can only enhance the high reputation his work has so justly earned. The *raison d'être* of the present piece of work is summarized in the author's own words as follows, "in order to give reliable information on applied entomology we must have at our command the knowledge gained by careful technical, or systematic, studies of the insects with which we have to deal."

The student of forest entomology has now such a work at his command in which no side has been overlooked. The author opens with a short historical summary, then the original description of the genus with translation, revisional notes and synonymy. This is followed by a detailed description of the imaginal and larval anatomy, illustrated by excellent figures.

The latter half of the work is occupied by a revision of the genus, together with systematic notes and descriptions of new species. It is a piece of work thoroughly investigated, carefully written, and beautifully illustrated. It will be studied by all students of insect morphology with considerable interest, and prove invaluable to the systematist also.

W. E. C.

Hopkins, A. D. Bark Beetles of the Genus *Dendroctonus*. U.S. Dept. Agric., Bur. of Entom., Bull. No. 83, pt. i, 1909, pp. xv + 169, 2 pls., and 102 figs.

This second monograph may be described as the practical or applied side of the above-mentioned investigation.

Full details are given as to the habits and seasonal history, and other facts relating to various species. Climatic and other influences, natural and secondary enemies, and the general methods of control are all very fully dealt with. Following these we have a review of each species dealt with in detail, and an excellent bibliography, the whole forming a distinct acquisition to the literature on forest entomology, fully maintaining the high standard of the entomological publications of the United States Department of Agriculture, which have long been the envy and admiration of European workers.

W. E. C.

Hopkins, A. D.—Insect Depredations in North American Forests and practical methods of prevention and control. U.S. Dept. Agric., Bur. of Entom., Bull. No. 58, pt. v, 1909, pp. vi + 57-101.

- Stebbing, E. P.**—On some Undescribed *Scolytidae* of Economic Importance from the Indian Region II. Ind. Forest Mem., 1909, vol. i, pt. ii, pp. 1-20.
- Troup, R. S.**—Note on Burmese in Wood (*Dipterocarpus tuberculatus*, Roxb.). For. Ec. Ser. No. 6, 1909, pp. 1-24, 3 pls. and 1 map.
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VI.—FISHERIES.

VII.—MEDICINE.

VIII.—ANIMAL DISEASES, ETC.

- Balfour, Andrew.**—Mosquitoes with Reference to Immigration and Horse Sickness, and Notes on the Destruction of their Larvae by Fish in the Sudan. Lancet, 1909 (Jan. 8th), pp. 100, 101.
- Duerden, J. E.**—Experiments with Ostriches—X. How the Bars in Ostrich Feathers are produced. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 474-487, 7 figs.
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- Holmes, J. D. E.**—Immunisation against Haemorrhagic Septicaemia of Bovines. Ibid., pp. 48-68.
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- Jowett, W.**—Biliary Fever or Malignant Jaundice of the Dog (Canine Piroplasmosis). Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 582-584.

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Newstead, R.—Reports of the Twenty-first Expedition of the Liverpool School of Tropical Medicine. Jamaica, 1908-1909: Section 1.—Medical and Economic Entomology. Part 1.—Ticks and other Blood-sucking Arthropoda. *Ann. Trop. Med. and Paras.*, 1909, vol. iii, pp. 421-469, pls. xiii-xv.

Neumann, L. G.—Notes sur les Pédiculides. *Arch. de Paras.*, 1909, T. xiii, pp. 497-537, 31 figs.

The new species are *Haematopinus latus*, H. (*Linognathus*) *praelongiceps*, H. (*Polyplux*) *quadridentatus*, H. (P.) *longulus* H. (P.) *bidentatus*, H. (P.) *echinatus*, H. (P.) *maniculatus*. Other species are also described and figured.

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Theiler, Arnold.—Stock Diseases Carried by Flies. *Transv. Agric. Journ.* 1909, vol. viii, pp. 41-51.

